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EDWARD FAHY:

THE BELTRA FISHERY, CO. MAYO AND ITS SEA TROUT *SALMO TRUTTA* STOCKS

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The Beltra Fishery, Co. Mayo and its sea-trout *Salmo trutta* stocks

by

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ABSTRACT

The sea trout stocks of the Lough Beltra catchment in Co. Mayo are described from a sample of 620 specimens collected in 1973 and 1974. These angler-caught fish displayed a low diversity in age categories and the samples contained few previous spawners. Variation in the success of parr growth in different years, between males and females and between A and B type smolts is compared. The incidence of A type growth is high, resembling that of a neighbouring catchment and the amount of B type growth can be related to length of the estuary.

The Beltra angling fishery for sea trout exploits mainly two year smolt post-smolt. Traditionally the angling clientele have originated largely out of state and the decline in catches in recent years is attributed to a smaller volume of tourism in the post-1969 period. Catch per effort does not correlate with the supposed availability of sea trout and angling effort is regarded as the main factor deciding the yield from the fishery.

INTRODUCTION

Reviewing the literature on sport angling Norling (1968) concluded that very little research and systematic fact finding had been or was being carried out in Europe. O'Connor (1972) identified the most common type of study possible as a simple fact finding exercise and Tuomi (1972) recommended that case studies dealing with specific issues should be published wherever possible.

Well documented sea trout fisheries in Ireland are few and are heavily concentrated in the Connemara region of Co. Galway. During the past decade details of the angling catch from the Burrishoole fishery have been published (see for example Anon 1978) but the sea trout fisheries of Co. Mayo have otherwise not been written up.

The objectives of the account which follows are twofold: trout of the Beltra fishery are described and key factors in their biology sought and the recent history of catches in this fishery is investigated in an attempt to identify what regulates the yield from the system.

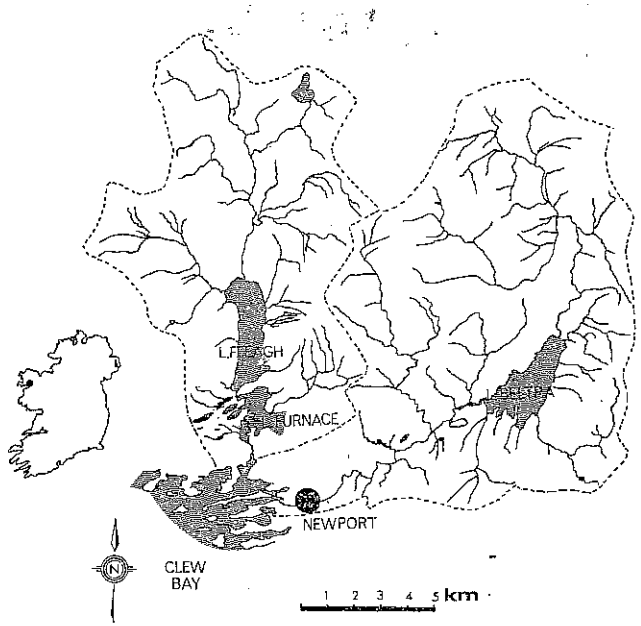

FIGURE 1. The Beltra catchment shown with the neighbouring Burrishoole system. (Based upon the Ordnance Survey by permission of the Government. Permit No. 1833).

The Beltra Catchment

The Lough Beltra catchment (shown in Fig. 1 with the neighbouring Burrishoole system) is situated on sandstone and quarzite. Its dimensions were estimated from the 1:126,720 O.S. map. Total area is 147 km^2 and lake area 4.3 km^2 approximately. River and tributaries total 81 km. Flanagan and Toner (1975) gave the maximum depth of Lough Beltra as 20 m. They reported the lake to contain soft water having a high colour, near neutral pH and significant quantities of iron. Phosphorus, nitrogen and chlorophyll levels indicated a system of low productivity. High total phosphorus levels, recorded at times, might be attributed to the presence of humic materials.

THE FISHERY

Newport House was purchased by Mr. H. Mumford-Smith in 1945 and opened as a fishing hotel in 1949. In more recent years it has been managed by a company of which Mr. H. F. Mumford-Smith is controlling director. Although guests are offered fishing on a number of other lakes and rivers in Co. Mayo (particularly the neighbouring Burrishoole fishery) a submission prepared for the Inland Fisheries Commission (Phelan, 1971) stated that two thirds of guest rod-days were spent on the Beltra fishery.

The hotel holds exclusive rights to both banks of the Newport (or Black Oak) River for some 11 km, its entire length. In addition it controls the western part of Lough Beltra on which there are 6 boats (12 rods) owned by the Hotel. The Eastern part of the lake is held by the Department of Fisheries and Forestry and is at present managed by the Glenisland Co-operative. The hotel has two boats there (four rods).

Fishery regulations specify fly only on the lake although the use of spinners and lures is permitted on the Newport River.

The Newport River has a long tidal estuary of about 5 km and Newport House has exclusive netting rights there. During the early years of the hotel the net fishery was operated commercially but in 1959/60 netting activities were reduced to the minimum considered necessary to preserve ownership and discourage trespass, in order to allow a maximum escapement to the rod fishery.

Angling Clientele

The fishery manager in Newport House Hotel (in the village of Newport) provides each angler with a proforma requesting certain statistics of the catch and there is in the lobby of the hotel a casual register of the kind previously examined by the writer elsewhere (Fahy, 1978a, 1979a) in which details of the catch by residents are entered together with a note on the number of days fished.

Mr. Mumford-Smith who has taken an interest in this aspect of the management of the fishery has kindly made available a number of private communications concerning the yield of the fishery and angler behaviour. Analysis of 2,000 rod days (from data collected in the late 1960s and early 1970s) quoted by Phelan (1971) indicated that revenue providing anglers (as opposed to local anglers who get concessions from Newport House) originated from:

Britain and Commonwealth countries	...	66%
Northern Ireland	...	8
United States of America	...	8
Continental Europe	...	10
Total out of State	...	92
From the State	...	8

Analysis carried out on fishery statistics in 1973 and 1974 showed that each guest spent on average 5 days on the fishery where the management are sufficiently conversant with the clientele to be able to classify fishermen as beginners or experienced. In 1973 and 1974 regulars (experienced) purchased 60% of rod days and took 79% of the recorded landings. Their catch per visit averaged 20 sea trout and 0.5 salmon. Beginners averaged 6 sea trout per visit.

Mr. Mumford-Smith also observed that experienced fishermen had a preference for lake fishing, 70% of them opting to fish there: 90% of beginners preferred the more informal river fishing. Analysis of sea trout catches in the Lough Beltra system for the 21 years from 1959 to 1979 showed that 33% of annual landings were made on the Newport River, 67% coming from the Lake.

Catches

Catches of salmon and sea trout recorded between 1959 and 1979 are set out in Table 1 and the catch per angling effort (rod/day) is summarised in Fig. 2 which also contains details of the average weights recorded over a more limited period and the total run of sea trout into the Burrishoole fishery. Fluctuations in the catch are irregular and bear no relationship to the run of sea trout in the neighbouring catchment.

THE SEA TROUT

Materials and Terminology

In 1973 and 1974 representative samples of rod caught sea trout from the Beltra system were examined; scales were removed and the length, weight and sex of each specimen noted. On days when few fish were caught all were examined but otherwise a proportion of the daily bag was sampled. The distribution of the sampled material in 1973 and 1974 is shown in Table 2. In all 222 fish made up the collection in 1973 and this total comprised 12% of the catch. The following year 398 sets of scales (from 20% of the catch) were amassed. Of these collections 198 sets of the scales collected in 1973 and 373 sets of the scales collected in 1974. were interpreted. Three back-calculations were carried out on each set of scales from pre-spawned fish and details of circulus formation in the parr centre of 6.5% of the total collection were also noted.

The scale formula convention for sea trout begins with a figure for the number of riverine winters. This figure is followed by a full stop, the number of marine winters and the number of spawning marks (S.M.). A plus sign signifies growth which did not culminate in a winter band.

Fish in their year of first migration to sea are known as post-smolt. "Adult sea trout" have completed their first post migration winter.

A-type smolts migrate to sea at the end of the last parr winter before any growth has taken place in the year of migration. B-type fish grow in freshwater either prior to their migration or while moving downriver.

Mean smolt age (M.S.A.) is calculated as:

$$(\% S1 + 2x\% S2 + 3x\% S3)/100$$

where S1, S2 etc. are the smolt classes.

The mean age at first maturation is calculated as:

$$(\% Y1 + 2x\% Y2 + 3x\% Y3)/100$$

Where Y1, Y2 etc. are sea trout maturing at the second, third etc. post-migration winter, Y0 represents the first post-migration winter, not included in the figures.

Results

A breakdown of the age composition of the two Beltra collections is given in Table 3. The samples are dominated by two year old post-smolt which feature prominently in the catches of west coast fisheries. The average weights of individual fish sampled in 1973 and 1974 were 477 and 352g respectively. The smolt of both post-smolt and adult fish were composed mainly of 2 and 3 year fish, 1 and 4 year olds together amounting to less than 1% (Table 4).

The mean lengths of all A and B type smolts are compared in Table 5. The average length at migration for 2 year old smolts (A type) was 19.7 cm and ranged to an average of 21.6 cm in B type 3 year olds. Relative growth in females and males is shown in Table 6. Two year smolt females were slightly but not significantly longer than males at the end of any freshwater year but even these differences were not apparent in three year smolt fish.

The freshwater rate of growth of two year smolts in the years 1971 to 1974 is compared in Table 7. The rate of first year growth was compared in three years and found to be significantly better in 1973 than 1972 ($P<0.001$); in their second year better growth was achieved in 1973 than in 1972 ($P<0.025$) or in 1974 ($P<0.001$). Finally, characteristics of circulus formation are provided in Table 8. Means of 17.0 in the first year and 20.3 in the second year were calculated.

DISCUSSION

General Considerations

The average weight of individual sea trout sampled in 1973 was 477g and the proportion of previous spawners was 18.2%. In 1974 the average weight at capture was 352g and the sample contained 11.0% previously spawned fish. These figures differ slightly from the expected value proposed by Fahy (1978a) in which a sample averaging 477g should contain about 17% previous spawners while one of 325g should contain about 7-8%.

Expressed in terms of an index of diversity (Williams, 1947) the Beltra samples contained relatively few age categories (Fahy, 1978b) and are thus in keeping with Irish sea trout stocks examined elsewhere. In 1973, 14 age categories were distributed among 198 individuals, an index of diversity (α) of 5 while in 1974 a similar number of age categories was distributed among 373 fish, an α value of 4. Similar values were encountered previously in sea trout from the Owenduff, 4.8 (Nall, 1931), Cashla, 4.5 (Went, 1956), 4.7, Foyle (Went, 1958) and 6.0, Burrishoole (Piggins, 1961).

Calculated as in Fahy, 1978b coefficients of total mortality were 1.86 in 1973 and 1.84 the following year. Mean age at first maturation in the 1973 sample was 0.66 sea years, 0.44 in 1974. These figures are almost identical to results obtained for sea trout from an east coast stock (Fahy, in press).

Sex Ratio

Information on sex ratio is comparatively rare in sea trout stock evaluations although the preponderance of females among sea run trout is generally recognised (Campbell, 1977). Within the Beltra collections (Table 3) the overall ratio of females to males was 1.22; among A type sea trout 1.26, and among B type fish 0.79. The higher ratio among A type sea trout suggests that females are faster growing, migrating earlier in the year. This phenomenon was also displayed among 2.+ post-smolt and A type sea trout in this category had a sex ratio of 1.81 while in B type fish the ratio was 1.38. However in 3.+ post smolt the position was reversed and the ratio of B type fish was 1.22 while for 3.+ A type fish it fell to 0.71.

Contrary to expectation the ratio declined in sea trout aged one sea winter. Among A type 2.1+ the sexes were equal but in B type trout of this class males outnumbered females. However the number of observations on these adult trout is small and it might be unwise to read too much into them before examining the sex ratios of other stocks.

The Parr Stage

The mean smolt age of the 1973 and 1974 collections combined was 2.23 years, a reading which is in general agreement with others made elsewhere at the same approximate time (Fahy, 1979b). As observed generally, B growth is higher in two than in three year smolts (Table 4). However the overall incidence of A type growth is very high; at 37% this statistic is similar to 34.8% recorded by Piggins (1961) for the neighbouring Burrishoole fishery.

The mean lengths of all 2 and 3 year smolts (the two most abundant classes in the samples) are averaged and set out in Table 5, which demonstrates that Beltra fish conform to patterns generally observed elsewhere. At the end of each parr winter B type smolts are slightly smaller than A type fish but B type growth takes them to a marginally greater length than A type fish at migration.

The amount of B growth and consequently its incidence can be related to the length of estuary traversed by a stock on migration. The size of the smolt may also be a contributory factor. For comparison the amount of B growth is calculated as ab/100

Where a = Mean B type increment (cm) in the two year smolt
and b = % two year smolts in stock.

For the Beltra fish the result of the calculation is 2.15 cm. Putting it in context with similar data already obtained:

System	Length of Estuary	B growth	Reference
Moy	10 km	2.96 cm	(Fahy, 1979b)
Beltra	5	2.15	
Vartry	2	1.84	(Fahy, in press)
Waterville	None	1.48	(Fahy, 1980b)

Growth

Freshwater growth is very similar to that in the neighbouring Burrishoole fishery where 3 year smolts migrate at an average length of 20.6 cm (Piggins, 1961); in Beltra their length at migration is 21.6 cm. Two year olds in Burrishoole go to sea at 19.3 cm; they leave Beltra at an average length of 19.6 cm.

To examine the relative growth of males and females, back-calculations for all 2 and 3 year smolt class of adult fish were bulked and grouped according to sex (Table 6). It has previously been stated that the effect of the later stages of freshwater growth and of the first marine winter is to progressively equalise length at age (Fahy, 1978b). Thus the growth intervals are greater between the age groups making up the 2 year smolts. However females were larger than males only in the first year of freshwater life in this group.

Growth Performance of Specific Year Classes

It has previously been observed (Fahy, 1979b, 1980b, in press) that the growth of certain year classes is better than others in certain years. Results so far reported indicate that the outcome of such trials is equivocal for 3 year smolt fish but two year smolts have followed a consistent pattern: significantly better growth years for fish in their first freshwater year alternates with years of significantly greater length at the end of the second parr winter. Three years' data were available for comparison in the Beltra collections and they are summarised in Table 7 from which it can be seen that this phenomenon also occurs there.

Circulus Formation

Fahy (1980b) has given details of circulus formation in the parr stage of two year smolt class sea trout from three parts of the Irish coast and the data presented in Table 7 are shown for comparison. At this stage it is not possible to identify distinctive features on the criteria given. However the total number of circuli formed in the first two years resembles this value in the Waterville, Co. Kerry stock (Fahy, 1980b) and is greater than in either a Connemara fishery (Crumlin, Fahy 1979a) or an east coast population (Fahy, in press).

The Exploited Stock

Apart from the high incidence of A type growth which the Beltra sea trout have in common with those of the Burrishoole system there is little to distinguish these sea trout from other west coast stocks. Parr growth and length at smoltification are close to those measurements in other west coast

fisheries and the Beltra fish are a typical short-lived population containing few previously spawned fish. Such stocks as these run into freshwater during the summer rather than the spring and the period in which they may be exploited most successfully is consequently short (Table 2).

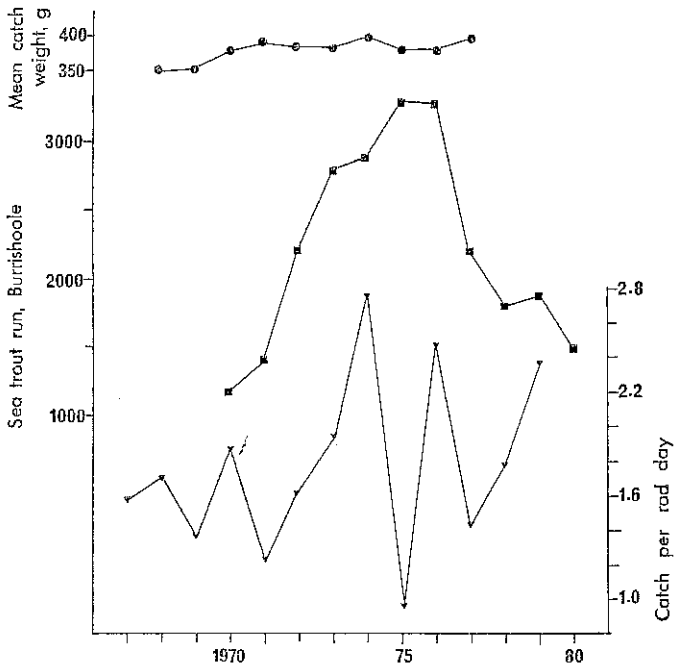

FIGURE 2. Recent catches of sea trout in the Beltra System compared with recorded run in Burrishoole System. Top: mean weight of sea trout landed; middle: numbers of sea trout (including post-smolt) entering Burrishoole System; bottom: numbers of sea trout per rod/day, Beltra System. Burrishoole figures from Annual Reports of Salmon Research Trust of Ireland Inc.

Estimates of total catch in the Beltra system are feasible only for very recent years in which statistics from the Glenisland Co-operative have been included. Working from the subtotals in Table 1 the catch would seem to have had three peak years since 1965 (1965, 1970 and 1974) but otherwise the trend in catch has been downward. Where such patterns have previously been observed (Fahy 1978a and 1979a) human/social rather than biological reasons have been invoked to explain the decline. A progressive reduction in catch per effort in sea trout fisheries has been noted (Fahy 1978a). In the late 1960s and early 1970s the clientele at Newport House came largely from outside the State. The decline in tourism since 1969 (Anon, 1980) is probably contributory to the fall in landings.

Where it has been examined elsewhere (Fahy, 1981) the yield per rod/day has maintained fairly constant values over the short term. This has occurred in spite of the indications that the availability of sea trout may have fluctuated considerably over the years (Fahy, 1980a, 1981). Careful counts of the numbers of sea trout entering the neighbouring Burrishoole fishery have been kept since 1970 and these counts are summarised in Fig. 2. Fahy (1981) has argued that such counts as these are likely to be indicative of trends in the availability of sea trout over a wide geographical area. When the catch per rod day in Beltra is related with numbers of sea trout counted at Burrishoole the correlation is not significant ($N = 9$; $r = 0.2864$). Mean catch weight (Fig. 2) does not correlate significantly with either total run into Burrishoole or catch per rod/day.

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TABLE 1. Numbers of Salmon (S) and sea trout (ST) caught in the Lough Beltra Catchment.

Year	East Beltra		West Beltra		Newport River		Sub-totals		Glenisland		Totals	
	S	ST	S	ST	S	ST	S	ST	S	ST	S	ST
1959			55	509	32	571	87	1,080				
1960	8	175	22	821	23	510	53	1,506				
1961	20	365	54	633	42	470	116	1,468				
1962	27	334	7	371	48	360	82	1,065				
1963	21	582	7	515	51	447	79	1,544				
1964	30	617	32	676	62	821	124	2,114				
1965	56	655	19	690	65	1,174	140	2,519				
1966	35	646	11	665	33	884	79	2,195				
1967	43	534	10	542	30	406	83	1,482				
1968	22	341	14	211	11	905	47	1,457				
1969	38	384	4	387	10	620	52	1,391				
1970	16	566	13	614	33	898	62	2,078				
1971	7	231	33	531	15	489	55	1,251				
1972	33	305	37	553	19	326	89	1,184				
1973	34	783	41	731	18	368	93	1,862				
1974	24	954	22	779	21	278	67	2,011				
1975	14	260	29	335	7	108	50	703				
1976	8	117	28	502	3	80	39	699				
1977	16	148	48	386	7	121	71	655	57	789	128	1,444
1978							?	686	33	211	?	897
1979	70	490			17	184	87	674	50	376	137	1,050

TABLE 2. Sample size (above) and composition (below) from the Beltra fishery in 1973 and 1974.

	1973							1974		
	June	July		August		September		July	August	
	16—30	1—15	16—31	1—15	16—31	1—15	16—30	15—31	1—15	16—31
	Numbers sampled:									
	14	12	86	58	19	19	14	158	142	98
	Percentage composition:									
2.+	50	58	49	27	10	21	50	58	69	60
3.+	21	24	23	21	16	11	7	17	11	14
Others	29	18	28	52	74	68	43	25	20	26

TABLE 3. Age composition of two sea trout collections from the Beltra system in 1973 and 1974.

		1973				1974				Totals					
		B type		A type		B type		A type							
Sea age	Formula	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	1973	1974	B type	A type	♂♂	♀♀
0+	1.+						1				1	1			1
	2.+	14	24	13	14	65	90	21	38	65	214	193	86	113	166
	3.+	6	12	11	12	18	22	14	10	41	64	58	47	49	56
	4.+		1							1			1		1
1+	1.1+				1					1			1		1
	2.1+	13	14	7	9	16	9	11	11	43	47	52	38	47	43
	3.1+	2	3	1	3	2			1	9	3	7	5	5	7
	2.SM+	5	6		1	2	2	4	6	12	14	15	11	11	15
	3.SM+	3	2		1	3			3	6	6	6	6	6	6
2+	2.2+	1	1					2	1	2	3	2	3	3	2
	2.1+SM+	2	3	3	1	5	4		2	9	11	14	6	10	10
	3.1+SM+		1	1		2		1		2	3	3	2	4	1
3+	2.2+SM+	1		1	2					4		1	3	2	2
	3.2+SM+	2								2		2		2	
	2.1+2SM+		1			1		1	1	1	3	2	2	2	2
	2.3SM					1		1			2	1	1	2	
4+	2.4SM+					1					1	1		1	
5+	2.1+4SM+						1				1	1			
										198	373	360	211	257	314
										Total collections		222	398		

TABLE 4. Age composition of smolts in both Beltra collections.

Smolt age	B type	%	A type	%
1	1	50	1	50
2	282	65	150	35
3	76	56	60	44
4	1	100		
Totals	360	63	211	37

TABLE 5. Length (cm) of A and B type smolts at the end of each growth stage—from 1973 and 1974 collections.

	N	Mean	S.D.
Two year old smolts			
B type			
At 1 year	256	6.59	1.86
At 2 years	256	16.44	2.79
After B type growth	256	19.74	2.45
B type growth as a percentage of length at the last parr winter = 20.1.			
A type			
At 1 year	127	7.40	1.99
At 2 years	127	19.65	2.71
Three year old smolts			
B type			
At 1 year	55	4.90	1.06
At 2 years	55	11.76	2.09
At 3 years	55	18.68	2.75
After B type growth	55	21.62	2.77
B type growth as a percentage of length at the last parr winter = 15.7.			
A type			
At 1 year	47	5.51	1.65
At 2 years	47	13.00	2.34
At 3 years	47	21.57	2.57

TABLE 6. Length and age of male and female two and three year smolt sea trout compared.

Age	Males N	Males $\bar{x}$ (cm)	Males S.D.	Females N	Females $\bar{x}$ (cm)	Females S.D.	P
2 smolt year fish							
1.	49	7.00	1.88	64	8.00	1.97	<0.005
2.	49	17.70	3.32	64	18.73	3.01	N.S.
B Growth	29	20.04	2.65	41	21.20	2.60	N.S.
.1	21	29.70	2.51	28	30.28	2.48	N.S.
3 smolt year fish							
1.	20	5.08	1.12	27	5.93	1.85	N.S.
2.	20	12.72	1.96	27	13.40	2.86	N.S.
3.	20	21.65	2.48	27	20.87	2.65	N.S.
B Growth	8	23.05	2.03	13	22.91	2.29	N.S.
.1	2	31.40	0.57	5	30.48	1.18	—

TABLE 7. Length at age of two year smolts in the Beltra System.

	1971	1972	1973	1974
At one year N	45*	109*	226+	
Mean length	7.30	7.54	6.49	
S.D.	1.79	1.94	1.87	
At two years N		45*	109*	226+
Mean length		16.90	18.40	17.14
S.D.		3.38	3.15	3.01

* Material collected mainly in 1973.
\+ Material collected mainly in 1974.

TABLE 8. Circulus formation in Lough Beltra sea trout.

Number of circuli formed per year					Scale length (mm) per circulus		Regression of number of circuli (y) on fork length (cm) (x)			
1st year			2nd year							
Number	Mean	S.D.	Mean	S.D.	Mean	S.D.	Number	r	Slope	Intercept
40	17.0	5.0	20.3	5.1	0.025	0.004	108	0.93	2.166	1.977

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